NORTHERN TERRITORY NATURALIST

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THE NORTHERN TERRITORY FIELD NATURALISTS' CLUB
FOUNDED 1977

The objects of this club are to promote the study of and interest in the flora and fauna of the Northern Territory and in its conservation. The club provides opportunities for discussion and dissemination of information among its members by regular meetings, publications and fieldwork. It works in close contact with scientific institutions wherever possible, and encourages the publication of scientific and informed popular literature in the various fields of natural history.

N.T.F.N.C. Subscription Rates: $12.00, Family membership $15.00

All members receive the regular newsletter Nature Territory and the N.T. NATURALIST. The Club holds monthly meetings and field excursions. Meetings are held in the N.T. Museum of Arts and Sciences theatrette, Conacher Street, Fannie Bay, at 8 p.m. on the second Wednesday of each month.

P.O. BOX 39565 WINNELLIE N.T. 5789

Advice to Contributors

Contributions to the N.T. Naturalist need not be members of the N.T.F.N.C., although all members are urged to contribute. Contributions may take one of the following forms:

Letter to the Editor

A letter should be a short comment on a previous publication in the N.T. NATURALIST, a comment on an issue of topical interest in natural history, or a brief report of a field trip. Letters may be handwritten provided they are well presented. Only one copy of a letter is required.

Notes

If you have made a series of observations (for example, on the behaviour of a bird or other animal) or have notes on something new or unusual in the field, then this is the place to report your findings. Contributions should be in the order of 200-500 words and provided with a title.

Articles

An article should run to a maximum of about 1500 words (four to five double-spaced typed, A4 pages) and deal with a topic in the sciences. It should be written in a manner intelligible to readers without a specialist knowledge of the subject. Articles should be appropriately illustrated by clear, black ink graphs, diagrams or photographs.

Cover: Carpenter Frog Megistolotis lignarius, *Rainbow Pool, via El Sherana. Photo Keith and Lindsay Fisher.*

A NEST AND HATCHLINGS OF *EMYDURA VICTORIAE* (Gray 1842)

Anthony M.A. Smith[1,2] and Timothy C. Wood[1]

At 7am on 21 October 1984, three hatchling *E. victoriae* (Gray 1842) were observed among leaf litter on the bank of a billabong associated with the McKinlay River, N.T., approximately 7km south of the Mary-McKinlay river junction. A nest containing a further seven animals in the process of hatching was discovered beneath the litter among the roots of a *Pandanus* clump.

The nest was approximately 3m from the water's edge and 1.5m above water level. At the time of laying, earlier in the dry season, the water level would have been closer to the nest site. The nest was a simple hole, roughly spherical (8cm diameter) in shape, with the base 12cm below the surface. The substrate was blacksoil rich in humus. There was no obvious neck to the nest chamber, but such a structure may have existed at the time of laying.

The eggs were hard-shelled and elliptical, as are those of other *Emydura* species (Cann 1978). Within the nest, one egg contained a dead but fully developed embryo, with its yolk still external to the abdominal cavity. Another egg was found crushed and empty. An additional four or five egg shells were in or near the nest and presumably the hatchlings from those were already in the water. Clutch size was 16 or 17. The exact number of eggs could not be determined as the shells had fragmented during hatching.

The average dimensions of the hatchlings appear in Table 1. They are larger than those reported for Fraser Island *E. krefftii* (McNichol and Georges 1980, Georges 1982) and Murray River *E. macquarii* (Thompson 1983).

The ten hatchlings were sexed on the basis of gonad morphology and six proved to be female and four male. This result is not significantly different to the 1:1 sex ratio expected under genotypic sex determination.

The specimens described here have been submitted to the Australian Museum, Sydney (Field numbers 30913-30923).

Acknowledgements

We thank Grahame Webb and David Choquenot for checking our sexing of the hatchlings and for comments on the manuscript.

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Table 1: MEAN DIMENSIONS OF TEN *E. VICTORIAE* HATCHLINGS

	Mean	Standard Error	Range
Total weight (g)	5.73	0.14	4.89-6.20
Yolk weight (g)	0.34	0.07	0.14-0.93
Carapace height (cm)	1.59	0.02	1.46-1.66
Carapace length (cm)	3.16	0.05	2.81-3.31
Carapace width (cm)	2.87	0.06	2.50-3.11
Head width (cm)	0.99	0.01	0.93-1.02

[1] Conservation Commission of the Northern Territory, P.O. Box 38496, Winnellie, N.T. 5789.

[2] Research School of Biological Sciences, The Australian National University, G.P.O. Box 475, Canberra, A.C.T. 2601.

SOME RECORDS OF SMALL MAMMALS FROM THE SOUTHERN NORTHERN TERRITORY

B. W. Strong and W. A. Low
c/- Conservation Commission of the Northern Territory
P.O. Box 1046
Alice Springs N.T. 5750

Introduction

During a three year study of the biology and distribution of the European Rabbit, *Oryctolagus cuniculus*, in the Northern Territory, records of small mammals were kept with the view that there might be some relationship between small mammal distribution and Rabbit distribution. Such an assessment would be a major study in itself and we present here a map (Figure 1) showing the locations of our records and some observations that may be of use to a more detailed study in the future. The observations were made between August 1980 and August 1983 and they supplement Parker's (1973) earlier records of the distribution of small mammals in the Northern Territory.

Methods

Elliott traps were baited with various mixtures of bread, peanut butter, bacon, and occasionally oats, nuts and even biscuits. Up to 16 traps were set out in two transects. Traps were set out overnight but on many occasions they were not set until around midnight.

Quite a few of the mammals were caught by hand under the glare of a spotlight.

Some of our records are from analysis of stomach contents of Feral Cats (Strong and Low 1983) shot during the study.

Other records, e.g. *Ningaui sp.*, are fairly certain sightings. We became quite adept at identifying *Antechinomys laniger* and *Notomys alexis* by their appearance, gait and the habitat. On the other hand, to distinguish between *Pseudomys* and *Mus* without a close examination was impossible and we often saw one or the other.

Results

In all we recorded 9 species (Table 1) including the introduced House Mouse, *Mus musculus*. Elliott traps were not successful, even where we knew there were small mammals about. In all we set a total of 289 Elliott traps on 19 nights for only seven animals trapped. The House Mouse would seem to be the most easily trapped. *Notomys* and *Sminthopsis* were relatively easily caught by hand, whereas *Antechinomys* were extremely agile. Among the small mammals *Mus* was the most common prey item of Feral Cats, followed by *Notomys* (Strong and Low 1983).

We saw large numbers of *Notomys alexis* on three occasions in 1982 — January in the Tanami, September on Erldunda Station and September on the northern end of Andado Station.

Antechinomys were mostly found in open calcrete areas south of the MacDonnell Ranges, a habitat much favoured by Rabbits. The one exception was a sighting on open granite plains and low hills near the South Australian border. Professional Rabbit shooters also reported seeing them in the area.

The one *Leggadina* was taken from a Feral Cat shot in a creek running into the Hale River. The nearest Rabbit populations were on the flood plains of the Hale, about 1 km away.

The *Macrotis* was seen on the spinifex sand plain country of the Tanami area which is an area relatively free of Rabbits.

Mus were found in a variety of habitats from calcrete plains through spinifex sand plain and sand dunes to the riverine habitats of the Hale and Hugh Rivers. Rabbits were found in the same general areas.

The *Ningaui* was seen in scrubby spinifex sand plain in the Tanami during a period when Gibson (pers. Comm., 1982) was live trapping the species. The area was relatively free of Rabbits.

Notomys were confined to spinifex sand plains and sand dunes north and south of the MacDonnells. Particularly in the south, they were found in areas occupied by Rabbits.

The *Pseudomys* were trapped on an open calcrete plain with perennial *Aristida sp.* dominating. Two *Pseudomys* were prey of a Feral Cat taken from a similar area in the north-west but with a thicker and more diverse vegetation cover. Both were Rabbit infested areas.

The two *Sminthopsis* were taken from different habitats. One was a thickly grassed (mainly *Aristida sp.*) alluvial plain and the other from a gently undulating open stony plain dominated by Chenopods. Both these areas are Rabbit infested.

The *Trichosurus* were found along major drainage lines on plains country associated with the Eastern MacDonnells. They favoured ironwoods *Acacia estrophiolata*, river red gum *Eucalyptus camaldulensis* and in one case acacia bush *Acacia victoriae*. Rabbits occur in the same areas.

Discussion

During the three year study, climatic conditions were dominated by summer/autumn rainfalls with dry winter and spring conditions. In general, except for the dry period during 1980, vegetation was moderately abundant with good seed supplies and insects were abundant.

Most of the mammals were seen in or near Rabbit infested areas, though not necessarily in the same habitat. Since most of our evening work was in Rabbit infested areas we cannot comment on the distribution of small mammals outside those areas.

Acknowledgements

The work was done while we were under contract to the Conservation Commission of the Northern Territory, supported by funds provided through the Feral Animals Committee.

Our thanks to Dave Gibson who helped with identification.

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Table 1: SMALL MAMMALS RECORDED FROM THE SOUTHERN NORTHERN TERRITORY BETWEEN AUGUST 1980 AND AUGUST 1983

Species	Number of Individuals			
	Hand Caught	Trapped	Sighted	Cat Prey
Antechinomys spenceri	6	—	17	—
Leggadina forresti	—	—	—	1
Macrotis lagotis	—	—	1	—
Mus musculus	4	4	(?)	5
Ningaui sp.	—	—	1	—
Notomys alexis	2	1	Numerous	2
Pseudomys hermannsburgensis	—	2	(?)	2
Sminthopsis crassicaudata	2	—	—	—
Trichosurus vulpecula	—	—	7	—

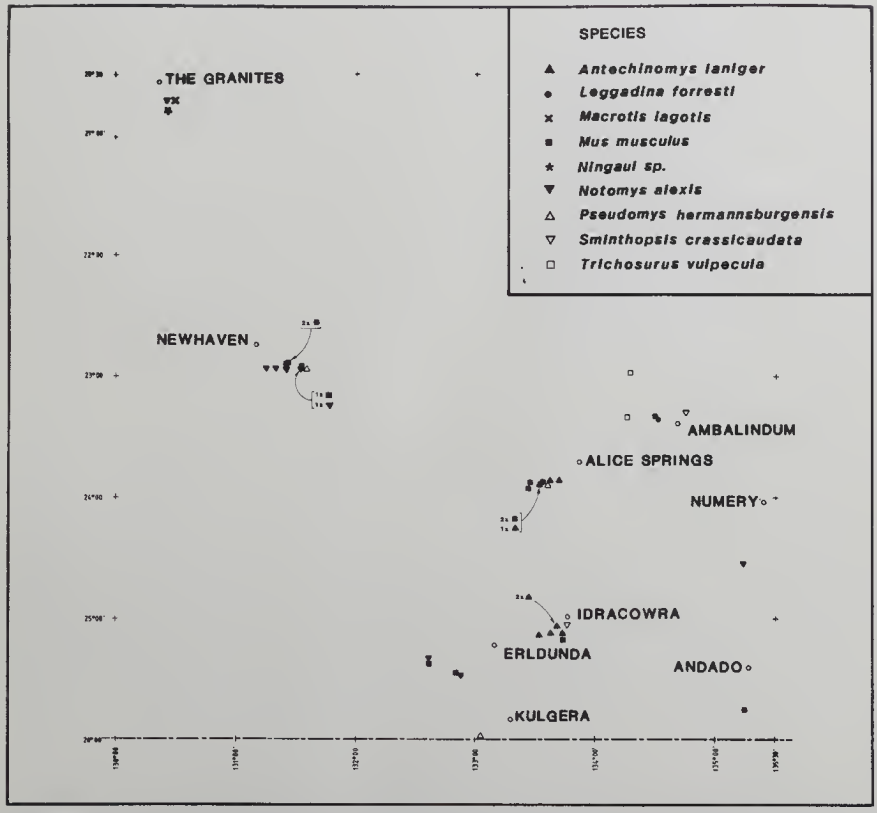

Figure 1: Some records of small mammals from the southern Northern Territory.

A SHORT NOTE ON SOME BIOLOGICAL CHARACTERISTICS OF THE EUROPEAN RABBIT *(Oryctolagus cuniculus)* IN THE NORTHERN TERRITORY

B. W. Strong[1] and W. A. Low[1]

Introduction

Between August 1980 and July 1983 the European Rabbit, *Oryctolagus cuniculus*, was the subject of a study to investigate its distribution and biology, and to find useful methods for its control within the Northern Territory. The major findings are reported on elsewhere (Low and Strong 1984 a, b, c, and d; Low, Cooke and Strong 1984; Low, Strong and Williams 1984; Low, Foran and Strong 1984).

In this short note we report on coat colour, sex ratio, age, specific weight and comment on other aspects that become of interest from time to time.

Coat Colour

In the collected samples of just over 2400 Rabbits up to eleven colour variations were represented. These have been grouped into six major types (Table 1). Other colour variations were sighted but they are not included here.

Agouti is the coat colour of the 'normal' wild Rabbit and is described by Stodard (1965a).

Our findings show slightly more yellow Rabbits than is normal for more temperate areas but this does not present any divergence from that which could have been expected for a more arid area. Stodard (1965a) reported that '...coat colour is lighter where rainfall is low and variable, the range of temperature is great and the extremes of temperature high. The coat is blacker where rainfall is greater and more reliable, the range of temperature smaller and the extremes of the temperature colder.'

We found no significant trends within the Northern Territory from east to west or from north to south, for coat colour.

Sex Ratio

The sex ratio of the sample was 0.75:1 (male:female). This closely follows the results of other workers (Dunsmore 1974; Parer 1977; Wood 1980; Shepherd, Edmonds and Nolan 1981). However, Dunsmore (1971) reported a sex ratio strongly favouring males at Mogo on the south coast of New South Wales while stating later that the dominance of females '...approximates what we believe to be usual in Australia'. The number of males and females for each age class is shown in Figure 1.

Shepherd, Edmonds and Nolan (1981) stated: 'Collections of Rabbits, which usually include a small percentage of the population and which are restricted to comparatively short periods of the day, may be particularly susceptible to sampling errors related to differences in behaviour between the sexes'. Over the three year period our samples were collected from various periods during the day and night, from all seasons and from all age classes. Thus most variations would be accounted for.

We found no significant difference in sex ratio in the Northern Territory between seasons. However, there was a significant difference ($P<0.01$) in winter between the N.W. region (1.26:1) and the S.E. region (0.64:1). There was also a significant

difference in summer between the S.E. and the S.W. but a small sample size precludes a definite statement.

Age specific weight

Data for calculating age specific weight was available for 2314 Rabbits. Rabbits grew rapidly up until aged between six and seven months when they reach 1200 g (Figure 1). All weights are paunched weights, i.e. the stomach, intestines and liver (and embryos in the case of females) were removed before weighing to account for any difference by ingested food, etc. Age is calculated from dried eye lens weight using the formula of Dudzinski and Mykytowycz (1961).

Males were generally heavier than females but the difference is not significant (Figure 1 and Table 2). No significant differences in weight were found in adult Rabbits from different regions of the Northern Territory (Table 2). (For comparison we divided the major area of Rabbit occupation into five regions — NW, NE Central, SW and SE, the central region being Alice Springs and the MacDonnell Ranges.) Casperson (1968) found very significant differences among four sites varying widely from semi-arid through sub-alpine and sub-tropical to a modified Mediterranian type. The lack of variation in the Northern Territory (semi-arid to arid) was probably due to the overall similarity of seasonal conditions experienced during the study.

Other physical features

i) Eye colour: The vast majority of Rabbits had brown eyes, however, one Rabbit had blue eyes, another had a partly blue eye and there was one albino with pink eyes. All three Rabbits came from the north-west region.

ii) Moulting: From time to time Rabbits are observed with much fur missing from their tails, legs and underneath in general. This is not to be confused with symptoms of myxomatosis but is a natural process of moulting and is reported on in detail by Stodart (1965b). It can also be caused by Rabbits plucking themselves to remove grass seeds and burrs (B. D. Cooke, pers. comm., 1982) and female Rabbits pluck fur to provide nesting material.

Conclusion

With regard to the physical features reported on here, the Northern Territory Rabbit population did not vary between major regions, and was similar to populations elsewhere in Australia.

Acknowledgements

The work was done while contract to the Conservation Commission of the Northern Territory, supported by funds provided the Feral Animals Committee.

Vanessa Low is thanked for modifying computer programs to process the data.

[1] c/- Conservation Commission of the Northern Territory,
P.O. Box 1046,
Alice Springs, N.T. 5750

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Table 1: PERCENTAGE OCCURRENCE OF COAT COLOURS IN RABBITS SAMPLES IN THE NORTHERN TERRITORY

Colour	Percentage Occurrence
Agouti	94.7
Yellow	4.3
Dutch Collar	0.3
Silver-grey	0.3
Black	0.1
Other*	0.3
100.00	

* Includes Rabbits with various white blazes and patches, one albino and one himalayan.

Table 2: MEAN WEIGHT (±STANDARD DEVIATION) (g) OF MALE AND FEMALE RABBITS 12 MONTHS AND OLDER FROM 5 REGIONS AND THE WHOLE OF THE NORTHERN TERRITORY

	NW	NE	Central	SE	SW	NT
Males	1435 ± 100	1444 ± 139	1448 ± 142	1437 ± 134	1376 ± 142	1429 ± 137
N	77	139	142	57	108	521
Females	1414 ± 121	1433 ± 164	1408 ± 148	1372 ± 140	1332 ± 148	1395 ± 153
N	73	172	154	78	134	611

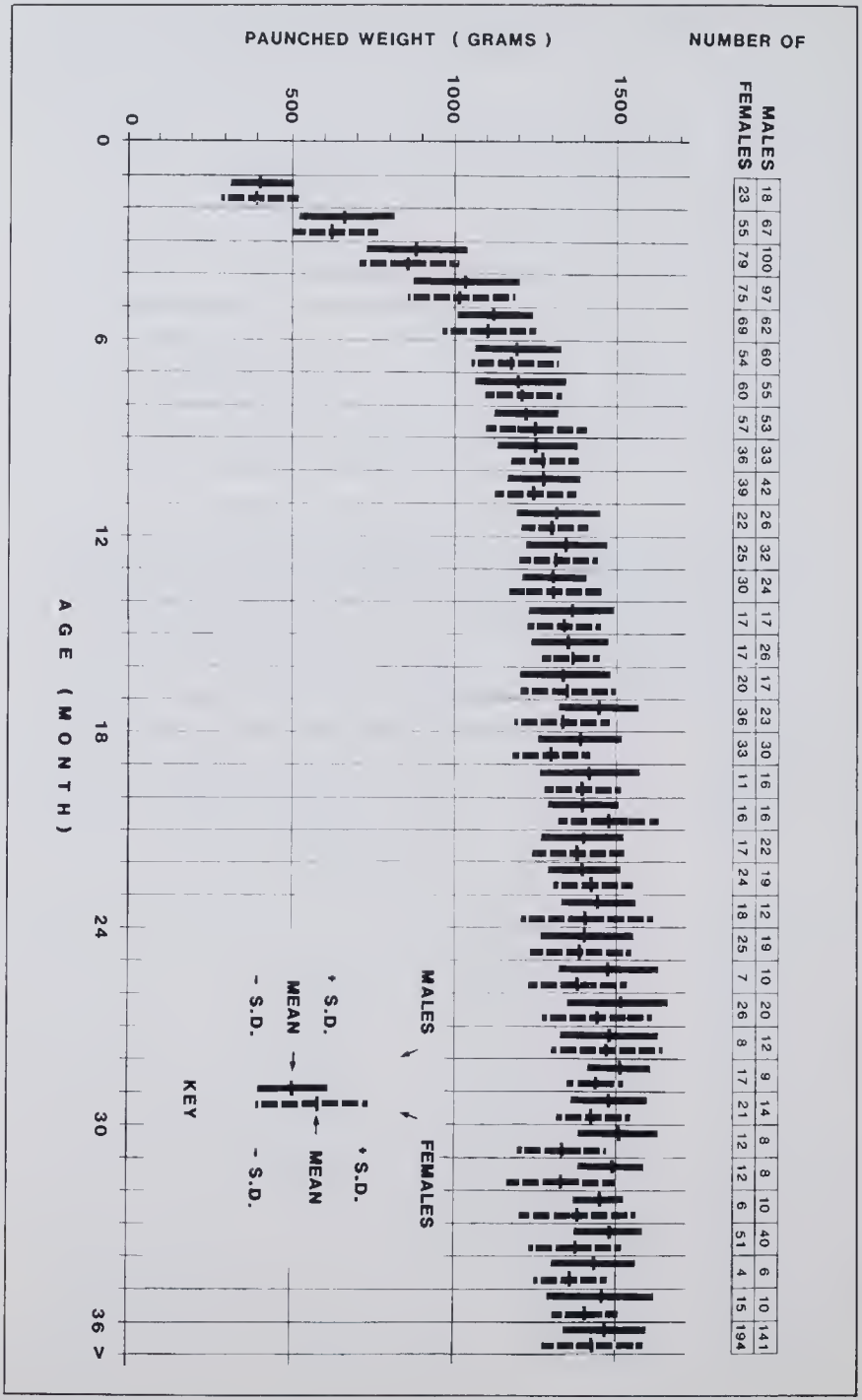


Figure 1: Mean (±S.D.) age specific weight of male and female Rabbits in the Northern Territory.

SOME OBSERVATIONS OF JASPER GORGE, VICTORIA RIVER DOWNS, N.T.

Keith and Lindsay Fisher

Four members of the Northern Territory Field Naturalists Club, Greg Wills, Grant Husband, and Keith and Lindsay Fisher, visited the Jasper Gorge area over the Easter period 20th-23rd April 1984. Jasper Gorge is situated 60km south of the Victoria Highway on the V.R.D. Station road. The road is formed gravel and passes through the gorge for its 10km length. A small camping area is situated at the eastern end alongside a billabong on Jasper Creek. The Jasper Gorge area is at present under consideration as a national park.

Three nights were spent at the gorge, spotlighting each night and walking along the gorge each day, downstream to Bottletree Waterhole and upstream to the road crossing of Jasper Creek. A small rubber dinghy was used on the billabong to observe the birdlife.

Evidence of aboriginal occupation was noted, stone and glass spearheads, as well as stone scrapers at scattered sites. Three rock art sites were found and a circular stone arrangement seen on the top of an escarpment.

BIRDS

Little Pied Cormorant	6 overflying campsite
Whistling Kite	2 patrolling Jasper Creek
Brown Goshawk	1 flying low along escarpment
Collared Sparrowhawk	2 soaring over top of escarpment
Brown Falcon	2 soaring over road by campsite
Australian Kestrel	1 in gorge
Peaceful Dove	Common in cleared areas, tracks and roads
Diamond Dove	2 disturbed in grass near Bottletree W/H
Bar-shouldered Dove	4 near Bottletree Waterhole
Crested Pigeon	2 flying along gorge road
White-quilled Rock Pigeon (subspecies *Petrophassa albipennis boothi*)	4 on escarpment 1km south of Bottletree Waterhole
Red-tailed Black Cockatoo	2 in Eucalypt south of Bottletree Waterhole
Galah	Several flocks flying around gorge
Sulphur-crested Cockatoo	15 feeding near campsite
Red-collared Lorikeet	2 overflying campsite
Red-winged Parrot	Several parties of 3 to 4 around campsite
Cockatiel	1 flock of 30 at western end of gorge
Northern Rosella	Several pairs flying around campsite
Pheasant Coucal	1 in campsite
Southern Boobook	8 spotlighted on the gorge road

Masked Owl	1 spotlighted on the gorge road and 1 coming out of tree hollow. Identified by size and call — observed 5 minutes
Australian Owlet Nightjar	1 seen in car headlights on road
Spotted Nightjar	1 spotlighted on gorge road
Azure Kingfisher	1 seen flying along Jasper Creek
Blue-winged Kookaburra	Several along creek, calling at dusk and dawn
Rainbow Bee-eater	Common in open areas
Black-faced Cuckoo-shrike	2 at western end of gorge
White-bellied Cuckoo-shrike	5 around campsite
White-winged Triller	1 near campsite
Rufous Whistler	6 eastern end of gorge
Grey Shrike-thrush	8 feeding in *Ficus leucotricha* (large leaf rock fig) at base of escarpment
Shining Flycatcher	2 pairs seen in *Pandanus aquaticus* alongside billabong at campsite
Northern Fantail	2 pairs seen alongside billabong at campsite
Willie Wagtail	3 alongside road in gorge
Grey-crowned Babbler	Several parties of 10-12 in and around campsite and along creek building nests/roosts
Variegated Wrens	1 male 3 female in escarpment 1km south of Bottletree Waterhole
Red-backed Fairy-wren	1 male 6 female in grass next to campsite
Weebill	2 in Melaleuca eastern end of gorge
White-throated Gerygone	2 in Melaleuca eastern end of gorge
Silver-crowned Friarbird	Common along Jasper Creek, feeding on *Xanthostemon paradoxus*
Little Friarbird	5 feeding with Silver-crowned Friarbirds
Blue-faced Honeyeater	7 overflying campsite
White-gaped Honeyeater	4 feeding alongside creek at campsite
Yellow-tinted Honeyeater	2 seen in *Eucalyptus pruinosa* at western end of gorge
Brown Honeyeater	Common in all areas
Banded Honeyeater	2 near Bottletree Waterhole
Mistletoebird	1 at campsite
Striated Pardalote (Black-headed)	Common all along Jasper Creek
Crimson Finch	1 carrying nest material into *Pandanus aquaticus* on billabong near campsite
Double-barred Finch	2 around campsite, 2 attending nest containing 2 eggs at Bottletree Waterhole
Long-tailed Finch	Flock of 9 seen in grass alongside Jasper Creek
Olive-backed Oriole	2 seen in *Melaleuca leucadendron* on billabong near campsite

Great Bowerbird	Common around campsite, 2 bowers found on opposite side of road from campsite — contents included clear glass, grey-blue road metal chips (from campsite track), ring pulls, bleached bones and brown fruits
Australian Magpie Lark	Common alongside road
White-breasted Woodswallow	3 flying over campsite
Masked Woodswallow	Common along gorge road
Black-faced Woodswallow	12 flying over escarpment east end of gorge
Pied Butcherbird	Common alongside road, calling around camp
Torresian Crow	2 overflying campsite

REPTILES

Crocodylus johnstonii Freshwater Crocodile	Seven in Jasper Creek
Gehyra australis Northern Dtella	One on top of escarpment
Gehyra nana	Several under exfoliations of sandstone
Heternotia sp. Gecko	One active on track at night
Lophognathus gilberti Gilberts Dragon	Several on termite mounds at entrance to gorge
Varanus mertensi Mertens Water Monitor	Two on bank of Jasper Gorge
Varanus mitchelli Mitchells Water Monitor	Two on bank of Jasper Gorge near camp
Cryptoblepharus megastictus	Numerous on vertical rock faces.
Ctenotus inornatus	Several active amongst spinifex and on rocky slopes
Ctenotus pantherinus	One spotlighted at night under log amongst spinifex
Morethia ruficauda Fire-tail Skink	Numerous active on sandstone escarpment
Notoscincus ornatus	Active in grass tussocks in dry creek bed
Dendrelaphis punctulatus Golden Tree Snake	One at base of escarpment also sloughed skin

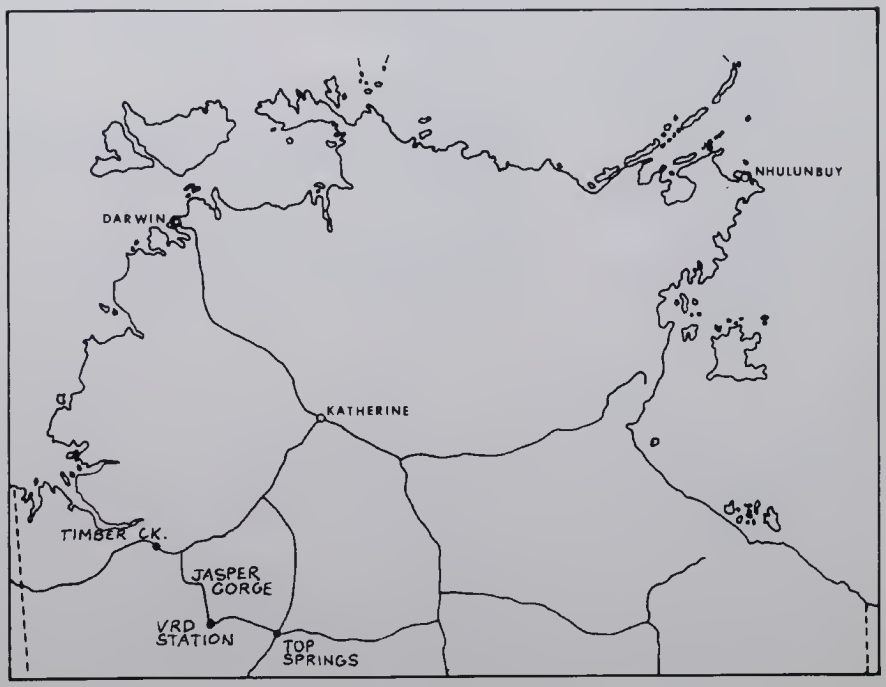
FROGS

Limnodynastes ornatus Ornate Burrowing Frog	Four active on track near camp.
Litoria coplandi Saxicoline Tree Frog	Several under rocks alongside creek during the day
Litoria meiriana	Numerous active on rocks around water
Litoria wotjulumensis	One beside camp at Jasper Creek
Megistolotis lignarius Carpenter Frog	One under rock in dry creek bed near camp

FISH

Melanotaenia splendida australis Western Rainbowfish
Oxyeleotris lineolatus Sleepy Cod
Nematolosa erebi Bony Bream
Toxotes chatareus Archer Fish
Ambassis sp. Glass Fish
Amniataba percoides Black Striped Grunter
Leiopotherapon unicolour Spangled Perch
Eel Tailed Catfish — unidentified sp.
All fish observed in Jasper Creek.

Acknowledgements
Our thanks to John McKean for advice and encouragement.



BRIEF NOTES ON THE GEOLOGY OF THE JASPER GORGE AREA

Brian Whitehead*

The sediments which outcrop in the Jasper Gorge area were laid down in the Victoria River Basin approximately 1000 million years ago. This basin was an intracratonic shallow gently subsiding centre of sedimentation in which over 5000 metres of sedimentation were laid down during the Middle and Late Proterozoic periods (1700-approximately 700 million years ago).

The prominent sandstone forming the gorge belongs to the rock formation called Jasper Gorge Sandstone. This unit consists of massive and blocky medium grained sandstone. The underlying rock types which belong to the Stubb Formation and the Wondoan Hill Formation consist of dark grey shale, siltstone, claystone, some mudstone and glauconitic sandstone.

The Wondoan Hill Formation was laid down in both shallow and deep marine environments. The Stubb Formation was deposited in a restricted, gradually deepening basin formed on the underlying Wondoan Hill Formation. The Jasper Gorge Sandstone was formed during a major transgression in which a shallow sea spread over the entire region.

All formations in the area are almost flat lying and undeformed, reflecting the stable techonic history of the entire region. Joints and faults are the only obvious structural features.

* Department of Mines and Energy
G.P.O. Box 2901
Darwin, N.T. 5794

THE SHRIMPS OF TROPICAL SEAS

A. J. Bruce
Division of Natural Sciences
Northern Territory Museum

In comparison with their relatives in temperate waters the shrimps of tropical seas have received comparatively little scientific study. This applies particularly to the northern shores of Australia. The larger species of commercial importance, the prawns, or members of the infraorder Penaeidea (Fig. 1a), are moderately well known, but the much larger number of smaller species of the infraorder Caridea (Fig. 1b), generally referred to as shrimps, have been almost entirely neglected. At present it is not possible even to guess how many kinds may occur in coastal waters of the Northern Territory but probably some 250-300 different species may well be present. A preliminary search of the literature has indicated only some 17 species. Most of the common and well known tropical species, such as *Conchodytes meleagrinae*, which occurs in pairs in pearl oysters, have not yet been formally recorded from this region, although it is virtually certain to be common in suitable waters where pearl oysters occur.

Shrimps are members of the crustacean order Decapoda, which also includes prawns, hermit-crabs, lobsters and crabs. All these are typically provided with five pairs of walking legs, some of which generally end in nippers. The "prawns" have the first three pairs of legs provided with small nippers and their eggs are cast loose into the sea. This is in contrast with the "shrimps", which do not have more than the first two pairs of legs with nippers, and whose eggs are carried attached beneath the abdomen of the female during development. The terms "prawns" and "shrimps" are used in quite a different sense in European waters and refer to species that do not occur in tropical waters.

The Classification of Common Tropical Shrimps

There are numerous families of shrimps that occur in tropical seas. Unfortunately these have not acquired any consistently used popular names in English. In shallow waters, the fauna is dominated by three families in particular. The two families of major importance are the families Alpheidae, (the snapping or pistol shrimps), and the Palaemonidae, as represented by the subfamily Pontoniinae. Palaemonid shrimps are common in shallow temperate waters where they are called "prawns". They are also conspicuous in tropical fresh waters but are rare in marine habitats, except for the numerous members of the specialized subfamily Pontoniinae. Of lesser importance is the family Hippolytidae. Numerous other families such as the Pasiphaeidae, Rhynchocinetidae, Processidae, Pandalidae and Crangonidae, are also represented each by a few species. One species of the latter family is the traditional "shrimp" of north-west European waters.

The alpheid shrimps (Fig. 2a), may generally be recognized by the presence of a well developed pair of nippers, or chelae, on the first pair of walking legs. These chelae are often very unequal or asymmetrical and one may be modified with a "pit and hammer" sound-producing mechanism. In many species a hood extends over the eyes, protecting them and obscuring them from view. The second pair of legs is very slender in comparison, similar to each other, highly flexible and armed with only tiny chelae.

The pontoniine shrimps (Fig. 2b) have the first pair of legs, slender and symmetrical, with only small chelae, whereas the second pair of legs is much more strongly developed and with large chelae, which may be similar and equal on each side of the body, or dissimilar and unequal. They have no popular name.

Hippolytid shrimps (Fig. 2c), many of which are often known as "grass shrimps" usually have only inconspicuous chelae on the first and second pairs of walking legs. The first pair is short and robust, whereas the second pair is elongated and slender, frequently with many segments and highly mobile, much as in the alpheid shrimps. However, occasional specimens do occur with large nippers as an abnormality.

General Biology

Most shrimps are rarely seen by day, even in shallow water. Many of the species are free-living but nocturnally active. By day they inhabit temporary burrows on the sea bed, or in permanent excavated burrows or other nooks and crannies. Others hide in holes in rocks or caves in reefs while several live amongst dense seaweeds, which they usually closely resemble in colour. Others are not free-living but live in a permanent association with some other marine animal. These are frequently referred to as "commensals" on the assumption that they do no harm to their host and are not therefore predators or parasites. The host animal therefore offers protection and possibly a source of nutrition, and many receive some benefit from its guest.

Many of these tropical shrimps are of very small size and so easily escape detection. *Fennera chacei*, which lives on certain branching corals, is adult when only about 5mm long. The general size range is only about 15-25mm although a number of species do reach about 80mm. Many species, both free-living and commensal, are cryptically coloured, and blend well into their appropriate habitats. Others can achieve invisibility by being almost transparent, or with only a few small flecks of colour. Almost all dislike exposure to light and take the first opportunity to hide themselves when disturbed, either by burrowing into the substrata or by shooting backwards into some small dark niche.

Reproductive Biology

Almost all of the tropical shrimps have eggs that hatch into a small larval stage that is quite unlike the adult. These are planktonic for an unknown period, during which they are transported by the local currents. During this planktonic phase the larvae grows and undergoes a series of moults and finally turns into a miniature shrimp. At this stage it ceases to be planktonic and settles on the sea floor to commence its adult life style. For the commensal species, this change is critical as they must locate an example of their appropriate host animal to have any prospect of survival. It appears inevitable that vast numbers must fail in this search. The host is probably located at short range by chemo-sensory means and once the juvenile has settled on its host it is unlikely that it will ever leave it again under normal circumstances.

Commensalism

Commensal shrimps are found in the three families Alpheidae, Palaemonidae and Hippolytidae and the phenomenon is characteristic of shallow tropical seas. It is rare in colder waters and there is little evidence of its extensive occurrence in deep seas, although some examples are known. The types of animals that act as host are of great diversity. Of particular importance are numerous sponges, many reef corals, sea ferns and whips, hydroids, anemones and even jelly fish. Many types of echinoderm may act as host; sea stars, urchins, cucumbers, feather stars and brittle stars may all have shrimps associated with them, as may many of the larger bivalve molluscs, such

as giant clams, oysters, pearl shells, scallops, fanshells and others. Many sea squirts also contain commensal shrimps. Others may be associated with fish, either living together in a shared burrow, or in a "cleaner" relationship where the free-living shrimp is reputed to remove parasites from passing fishes, which are attracted to its station by its behaviour and colour pattern.

Very little is known of the biology of these commensal species. The associations are generally very highly specific and in many cases the shrimp guest closely matches the colour patterns of the host animal so that it can only be discerned with difficulty. In fact, many have been found more by accident than design. This applies especially to the species that live inside clams or sea squirts, as the host animal has to be cut up to find them. In these cases, the shrimps are nearly always present as a male-female pair. In sponges and the various coelenterates, many of which can reach a considerable size, many individuals of several species or even genera may often be found. As yet there is no information on the growth rates or longevity of these shrimps and very little is known about their feeding habits. Some of the free-living species are undoubtedly micro-predators, feeding on still smaller crustacea or worms. It appears probable that some of the commensal species may be mucus feeders. Mucus is now known to be a rich food source and is produced in large quantities by many of the animals that are utilized as hosts. Other species may be cleaners. The alpheid shrimp *Aretopsis amabilis* lives in pairs in safe gastropod shells occupied by large hermit crabs, where it may be a faecal feeder, thereby cleaning the inside of the shell. Others may feed on the tissues of the host animal, thus being predators or parasites. Some of the species of the pontoniine genera found in association with sea anemones have been found to have stinging cells derived from their hosts in their stomach contents. A few species may be specialized plankton feeders. As yet there is very little precise information on their feeding relationships.

One of the most interesting aspects of the biology of tropical commensal species is the specialized adaptations that they show to their ecological niches. The pontoniine shrimps of the genera *Stegopontonia* and *Tuleariocaris*, that live on the long slender spines of some sea urchins, are remarkable for the very slender elongated form of the body, and feeble development of their walking legs. In contrast, the shrimp *Paratypton siebenrocki*, has an adult female that can only be described as globular. This shrimp occupies, with its smaller mate, a small rounded cyst-like cavity in the skeleton of some stagshorn coral. It is probably not really as rare as the few records of its occurrence suggest, it is just that it is very rarely found. Also found in corals, the alpheid shrimp *Racilius compressus* shows remarkable compression of its body from side to side, enabling it to move freely in the narrow spaces between the coral branches. In contrast, in the same coral host the pontoniine shrimp *Platycaris latirostris*, a sluggish form, is flattened from back to front. Many species have the claws at the ends of their legs modified, presumably to provide a better grip on their hosts, and some species have the tail fan also provided with hooks. Most species do not need the large nippers for holding onto their host and these seem to be used mostly in attack or defence. Some are capable of giving a sharp nip despite their small size. The alpheid genera *Synalpheus* and *Alpheus* and the pontoniine genera *Perclimenaeus* and *Coralliocaris* contain species that are capable of sound production, and the species of *Alpheus* are responsible for a lot of underwater noise on coral reefs, but the function of these sounds, if any, is unknown. Except in the genus *Coralliocaris*, only one of the large nippers is modified for sound production and these chelae are often greatly enlarged, almost equal to the size of the body of the shrimp.

Collecting Methods

Shrimps may be collected by a variety of methods. Some can be found under stones or small rocks on intertidal beaches and others are found in shore pools. The use of small hand nets amongst shallow water algae often produces an unexpected variety of small shrimps as well as other crustaceans. A fine-meshed hand held net, when swept through seaweeds, the tentacles of an anemone, the branches of a gorgonian or the fronds of a soft coral, will often reveal the presence of associated shrimps. For this purpose a net with a small transparent container at its apex is often most convenient. The shrimps caught, which may be small and transparent, swim downwards into the container and are more easily seen. In deeper waters, specimens are often obtained from trawl, dredge or grab catches. Undoubtedly the method that has produced most information over recent years is hand collection by snorkel or scuba-divers. Here the methods are precise and the exact depth, habitat or host are known. Shrimps can be chased and caught with hand nets or guided into small polythene bags. In addition, suitable host animals can be sampled and brought up in polythene bags for detailed examination. This method is especially suitable for large sponges or corals, which have to be broken up to extract the associated shrimps. Most species are quite delicate and easily damaged and so are best gently handled by means of fine forceps. Some host specimens are best brought up from the sea bed in dust-bins! Divers operating at night have frequently been surprised by the abundance and variety of shrimps, especially on coral reefs. When caught for scientific study, shrimps can be preserved in 8% formaldehyde solution or 70% spirit. The latter unfortunately rapidly destroys the attractive colour patterns that many species possess while formaldehyde destroys the colour pattern more slowly.

Generally it is best to allow the shrimps to die before placing them in preserving fluid, as the sudden shock of preservation will often cause them to shed their legs. Their death can be expedited by refrigeration on ice or by overheating from sunlight. Often it is necessary to put them in a small plastic jar or tube with some fragments of seaweed or other material, as they often tend to attack one another with vigour when in a confined space. Interesting specimens are best placed in separate tubes or small plastic jars so that no damage to them occurs. It is generally necessary to have intact specimens in order to establish their identity. With the alpheid shrimps, it is often necessary to have both male and female specimens, as the chelae may differ in the two sexes.

All specimens should be carefully labelled with details of locality, habitat, host, depth and means of collection, date, and name of the collector. A note of the colour pattern is often a useful addition, and, for the commensal species, the host or at least a portion of it, should also be preserved for specialist identification. Waterproof ink on good quality paper is best for specimen labels and should be placed in the containers with the preserved animals.

Zoogeography

Most of these tropical shrimps occur throughout vast areas of sea. Although the distributions of many of the less common species are not yet accurately known, it is clear that many extend from the northern Red Sea to the Tuamotu Islands, i.e., throughout the whole Indo-West Pacific faunal region. This pattern must be facilitated by the distribution of the planktonic larvae by ocean currents. Some of the Indo-West Pacific species have succeeded in crossing the East Pacific Ocean Barrier and successfully colonized the tropical western American seaboard. It is noteworthy that a particularly large proportion of these are species of commensal habits. A few species are known to be circumtropical.

Conclusions

The first step in any study of the marine fauna is to determine what species of animal occur, then to identify its habitat, distribution and assess its abundance, followed by more detailed studies on their biology. Much of the collecting necessary for this work can be readily carried out by interested amateurs, who, in this part of the world, stand almost as much chance of finding something exciting or new as the professional zoologist. Many of the free-living species survive well in aquaria if isolated from potential predators. Some of the commensal species can also be kept, if the host animal can be kept under aquarium conditions, such as the shrimps from sea anemones or starfish. Anyone finding crustaceans of interest, or from unusual or rarely visited localities, is most welcome to bring them to the Division of Natural Sciences of the Northern Territory Museum.

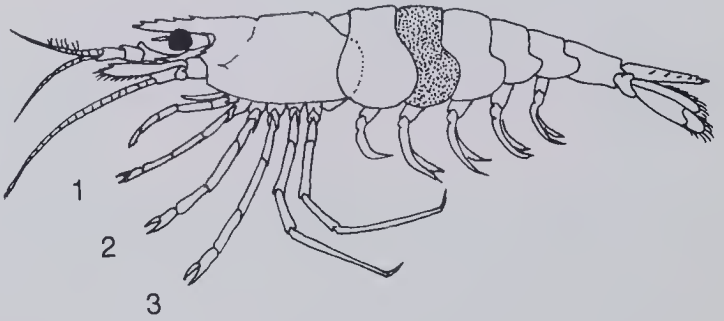


Figure 1a: Diagrammatic penaeid prawns, showing chelate pereiopods 1-3 and first abdominal segment posteriorly overlapping the second (shaded).

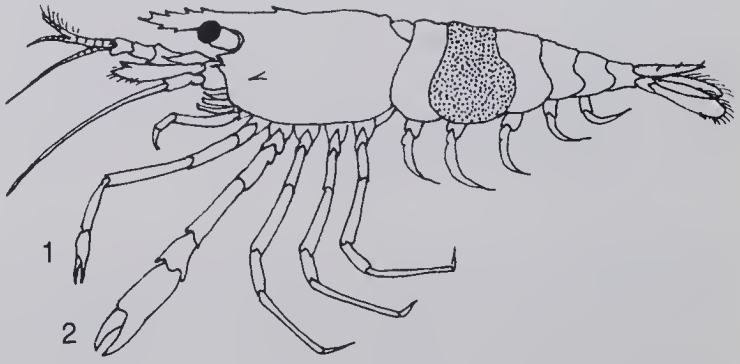


Figure 1b: Diagrammatic caridean shrimp, showing chelate pereiopods 1-2 and second abdominal segment (shaded) overlapping first anteriorly.

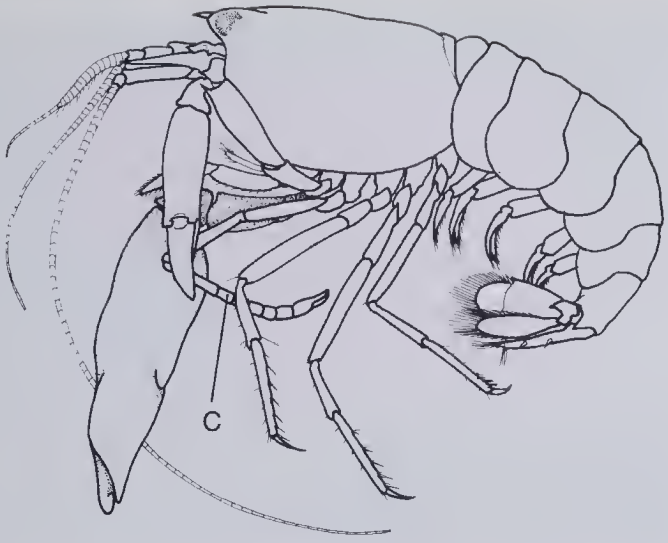


Figure 2a: Alpheid shrimps — First pair of pereiopods very robust, usually markedly unequal; second pair slender, carpus multi-segmented (c); eyes usually hooded by carapace; rostrum short, unarmed.

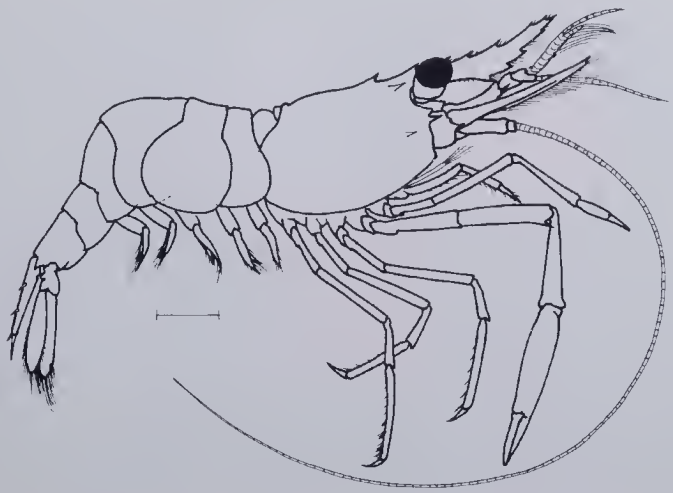


Figure 2b: Palaemonid shrimps — First pair of pereiopods slender; second pair robust, generally subequal; rostrum well developed, often dentate; eyes not concealed.

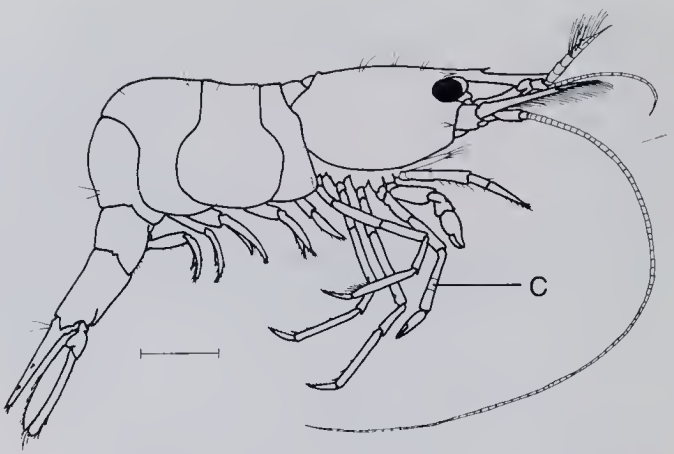
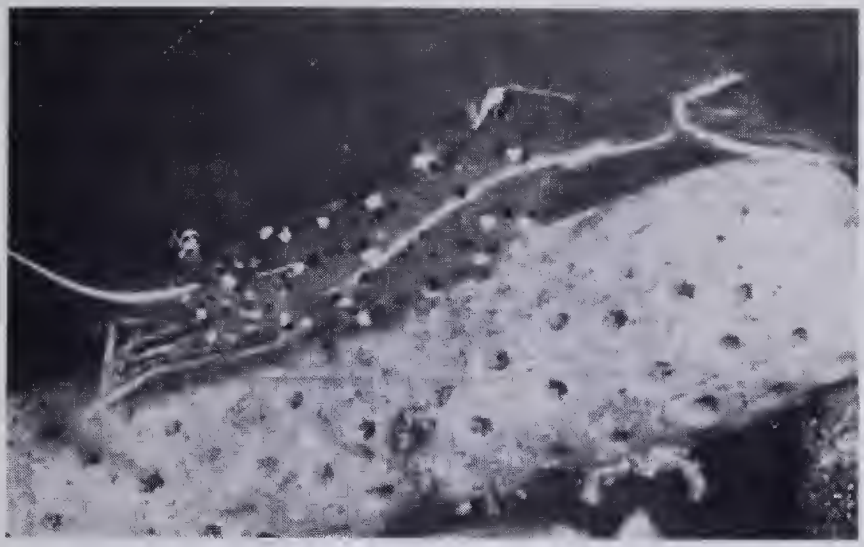
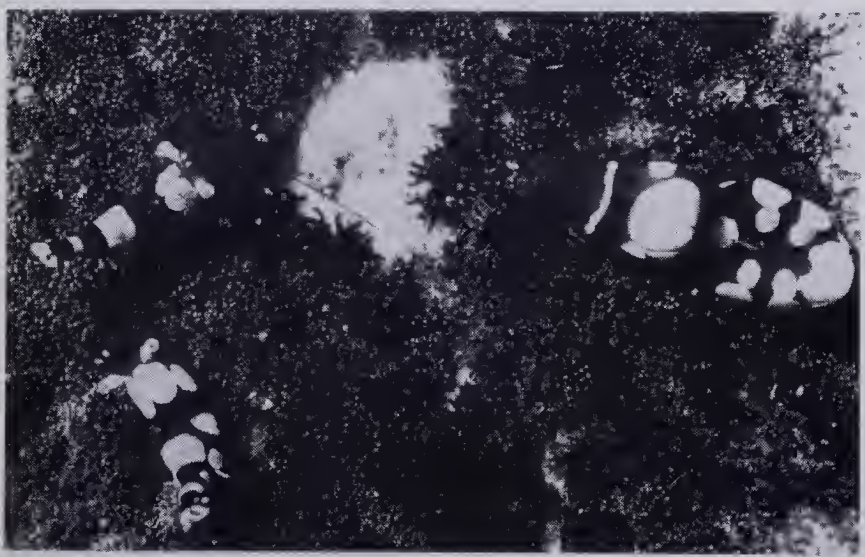


Figure 2c: Hippolytid shrimps — First pair of pereiopods generally small and robust; second pair slender, carpus multi-segmented (c); eyes not concealed.



Leandrites *sp., a palaemonine shrimp that behaves as a fish cleaner. It occurs in Darwin Harbour, where its yellow markings make it conspicuous.*



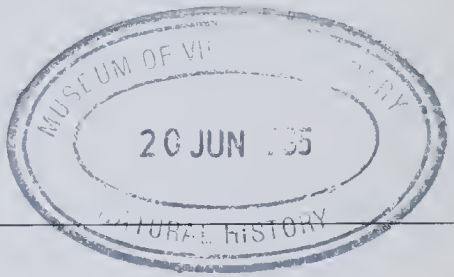
Thor amboinensis *(left), hippolytid shrimps and* Periclimenes brevicarpalis *(right), a pontoniine shrimp that may be commonly found together on giant anemones.*

Thorella cobourgi, *a minute hippolytid shrimp, about 5mm in length, first discovered in the Northern Territory amongst shallow water algae.*

Chernocaris placunae, *a pontoniine shrimp about 20mm long, that lives in male-female pairs inside window-pane clams (*Placuna *sp.).*

N.T. Museum curator making collections of soft corals for their associated shrimps.

Journal of the Northern Territory Field Naturalists' Club



CONTENTS

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